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Implementation of Global Carbon Cycle in GISS ModelE GCM: from Leaf to Planetary Scale

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We present a model of Global Carbon Cycle as it is implemented inside the NASA Goddard Institute for Space Studies (GISS) ModelE General Circulation Model (GCM). The model consists of three integral components: 1) the atmospheric model which performs the transport of CO2 by means of Quadratic Upstream Scheme (QUS), 2) the Ocean model which has its own algorithm for tracer transport and which employs Watson Gregg's ocean biogeochemistry model for computation of carbon fluxes and 3) Land Surface model (LSM) which incorporates Ent Dynamic Global Terrestrial Ecosystem model (DGTEM). In this presentation we will mostly concentrate on a Land Surface component. Ent was developed as a process-based vegetation model capable of predicting the seasonal and inter-annual vegetation growth and providing the fast time scale fluxes of water, carbon, and energy between the land-surface and the atmosphere. It employs well-known photosynthesis relationships of Farquhar, von Caemmerer, and Berry and stomatal conductance of Ball and Berry. Soil CO2 fluxes are also computed by the Ent according to the CASA soil biogeochemistry model. We will start with presenting simulations for single Fluxnet sites and then will show the results for fully coupled GCM runs. For GCM simulations, we present results of both equilibrium and transient runs and discuss implications of biases in GCM-predicted climate for accurate modeling of the global carbon cycle.